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THE FUNCTION OF EDUCATIONAL INSTITUTIONS

IN DEVELOPMENT OF RESEARCH

by

JOHN C. MERRIAM

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JOHN C. MERRIAM

In this day of application of science in every department of human interest, we naturally find investigative work conducted by a great variety of institutions. The relating of research to this wide range of activities is now recognized as essential. It is also considered important that in all types of constructive work there be a certain similarity in method of approach, but recent studies have raised a question concerning possible duplication of effort, and therefore of inefficiency in our organization of science and research.

author

The following note has been written with the aim to define the special functions characterizing research of educational institutions in contrast with those of other organized effort directed toward the advance of knowledge. For the purposes of this discussion it has been necessary to consider a tentative classification of fundamental types of research agencies. Fuller recognition of the specific objects in these several fields of endeavor, it is believed, may lead to larger efficiency and better scientific organization of the country as a whole.

Without assuming to present a complete or exact classification, we may divide our greater research efforts into five groups: (1) research of practical application in engineering laboratories; (2) governmental bureaus and laboratories; (3) research foundations; (4) museums and allied institutions; (5) educational institutions. To these five a

complete statement would add several of lesser magnitude, among which a very potent force is found in effort of individuals working privately, as has been done to the great advantage of science by many pioneers in investigation. In order to make clear the position of educational institutions with relation to the other four kinds of research agencies, it is necessary to give an approximate definition of each type.

(1) The expression of research referred to as "practical application in engineering laboratories" includes use of science in development of economic interests in the great variety of ways in which investigation contributes to the good of mankind. The words "engineer" and "science" are here used in the widest sense, covering the applicers of knowledge secured by investigation. The operations of this group might be illustrated by the constructor of railways, the builder of aeroplanes, or the dentist. The work of the engineer in all of the fields in which he operates may unfortunately be carried on by rule of thumb application without consideration of the special merits of each case. The true engineer we all recognize as one who views each problem as a new subject for special study. In a large measure his judgment must be based upon previous experience with similar studies, but his greatest success comes through realization of the fact that each bridge to be built, whether it be intended to cross a river or only to reach from one tooth to another, presents a special problem not identical with any previously considered case; and that failure to see the individual peculiarities may mean inability to make full use of the principles which are his instruments. The successful engineer is continuously engaged in the application of research methods.

In a still larger sense does the engineer concern himself with research problems by consideration of questions which are not merely specific applications, but involve principles which must be better understood before he is able to proceed. The dentist recognizes that knowledge of microscopic

structure of the tooth is of fundamental importance in his treatment of tissues if this work is to have value in a degree of permanence measured in years or tens of years. The railroad builder realizes that not all rock foundations give real stability to a railway bed, and that an understanding of the material through which he cuts may determine the ultimate value of his constructive work. These investigations in engineering inquiry we often designate as research in applied science. They differ from those in so-called pure science only in the fact that the research of the engineer is specifically directed, and by nature of the inquiry is rather narrowly limited; whereas the real solution of the problem may lie in a rather remote field. The railway builder may find the answer to his engineering questions in special phases of chemistry or petrography which were not included in the curriculum of his training course.

Even with the limitations which are set in investigations designed to meet specific needs in restricted fields of applied science, we must recognize that the everyday operations of great laboratories conducted by far-seeing corporations are developing some of the most significant advances in fundamental science of today. The student of pure science must always keep in close contact with these special researches, both to be helpful and to receive from the engineer the great wealth of data which should be incorporated into the organized body of fundamental science.

(2) Government institutions, as exemplified by the federal bureaus and laboratories of the United States, represent a field which is in some respects intermediate between that of engineers who apply and that of the special students of pure science concerned only with the principles of their subject. The laboratories of government departments exist for the special purpose of contributing for the benefit of the community. It is necessary that they serve as sources of information for practical applications and for interpretation of the principles of science to the great group of enquiring engineers throughout the country.

Consideration of scientific problems relating to specific community needs leads the government bureau to undertake far-reaching and fundamental investigations in the broadest fields of applied science. Such researches, by reason of the wide range of interests covered, may extend farther than the studies of the engineer or the corporation. As institutions which stand for a continuing people, the government bureaus should be able to undertake inquiries from which results might first become available to later generations. It is unfortunate that budget requirements and responsibilities of political parties tend to limit us in handling of projects which should be continued for long periods or with large funds, for the expenditure of which immediate returns may not be visible. It is presumably true that all science has its application in one form or another, but exceptional vision is required in organization of government work to make it clear that every phase of each investigation undertaken represents efficient application of science for real needs. By reason of its practical limitations the government organization may lose opportunity for consideration of certain critical problems, the settlement of which would ultimately be of great advantage to the state.

(3) Research foundations, with ample resources, freedom of choice in selection of objectives, and with trained men of vision directing their researches, have given opportunity not otherwise available for exhaustive investigation of fundamental problems and groups of problems without regard to the time required in the study, and without reference to immediacy of pressure for application. These institutions have in some measure covered the fields for basic investigation which the corporation engineer and the government bureau could not readily reach. The efficiency attained by these foundations, the vision with which their problems have been selected, and the great contributions which they have made to science, to human thought, and to application of science in everyday life, rank among the greatest achievements of American science.

(4) The great museums of America have been strongholds of research in the natural sciences. Their function has generally involved the special study of wide or narrow geographic regions to which they are related through circumstances governing their origin. The museums have also served a most important purpose as educators in natural history, supplementing in a vital way the work of the schools and universities. Through interpretation of science to the great public the museums have greatly assisted in the effort to make knowledge and reason the basis of our community judgment, and to give research the fullest opportunity to serve the people.

In organization of purely research projects the museums have contributed a large share of the material upon which the advance of American natural history has been based.

The work of these institutions is in general characterized by their peculiarly close relation to the public welfare, both in effective educational work and in the support of fundamental investigations for the sake of their human interest. They fill a most important place in the scheme of our research development.

(5) The educational institutions of America, as represented by the universities and colleges, have always had a large place in the advance of knowledge in all its phases and in its application. Their range of operation in constructive scholarship has been as wide as the limits of learning and its use.

In schools of engineering and agriculture, research has been largely on specific problems of application not differing from those of the engineer's laboratory or the government bureau. Here, as in the departments of fundamental science, the researches have also ranged into all phases of description, organization, interpretation, and analysis in special phases of science for which no immediate application is considered. These activities have been financed in some part by the universities, and in part from the pockets of the professors. Considerable support has also come from

business interests, from government institutions, and from research foundations.

The university or college includes constructive work as a necessary part of its regular programme for at least four reasons, which may be stated as follows:

(a) Investigation is an indispensable means of keeping the faculty in a position to present the most fundamental and most advanced knowledge through its teaching.

(b) Training in creative or constructive work is one of the most important phases of teaching and can be carried out successfully only through actual experience of the student.

(c) The state will naturally depend upon the institution of higher learning as an exceptionally organized group of constructive experts prepared to consider urgent questions requiring investigation.

(d) As a body representing a wide range of closely interlocking subjects having continuous relation to research in one form or another, the university affords unusual opportunity for correlation of knowledge on questions in new fields of thought.

In considering the first reason (a) we must realize that, even if the universities be assumed to exist only for teaching, they are expected to present the most advanced thought, and we cannot keep them in a position of leadership in understanding and in training without a faculty continuously setting forth the best in thought and experience in every subject. This condition can be maintained either by continuous research on the part of the faculty or by continuous renewing of the membership of the faculty. Continuous replacement of individuals is impossible, as the institution is a great and complex instrument in which the parts can be kept in proper adjustment only through long contact. It therefore becomes necessary for the faculty to keep its position by continuous growth of its members. If this process is merely imitative, the teacher is not an authority. The only way in which he can be assured of

growth is by working in his specialty. This constructive operation involves intimate knowledge of the fundamentals of his subject and definition of the limits and relationships of his chosen field of study.

More than this, the function of teaching in an educational institution does not concern alone the retailing of facts already assembled: it must include that kind of understanding of the subject which will prepare the student for his task as a leader in the future. To become such a leader the student must look beyond our present knowledge and experience with the expectation of accomplishing things which have never before been done. No good instructor can avoid recognizing this need of his students. No teacher who sees this requirement can fail to make a serious effort to determine the direction of advance in constructive use of his subject, if for nothing more than to point out to students the trend of the path and the preparation necessary for those by whom it will be extended to new fields of usefulness. It is hardly possible for the instructor to obtain a clear view of future development in his subject without intimate personal relation to the most advanced work in progress.

From the point of view of the student, training in constructive work or in development of creative imagination, suggested in point (b), must be considered of importance at least equal to the securing of information or the disciplining of the mind to habits of work. As in no other type of mental attitude, this involves the acquiring of a distinct love of the work and understanding of its purpose. It is not conceivable that the university will neglect this extraordinarily important aspect of the student's preparation for future activity or that it will expect him to proceed without guidance. If this particular phase of educational activity is not to be eliminated, it places upon the instructor the requirement that he stand before the student as an unmistakable representative of creative work, and as illustrating in his personal attainment

the end or purpose of his effort. Evidence of any other attitude on the part of the instructor will make useless whatever attempt he may make to serve as a leader or adviser in the field of constructive study.

The third contribution of value (*c*) furnished by research related to education concerns the immediate use of the results of this study by the community. While the university is naturally assumed to be primarily an educational institution, it has been made clear that without continuing research it can neither provide adequate instruction nor maintain its leadership in the educational work required. Constructive problems in all departments of investigation must be continuously the subject of successful handling, and the results of this work will be products of the first importance to the community. It is natural that to such an institution the whole people will look for the appearance of new ideas of broadest significance and of practical value. It is to be expected that the state will depend upon the university for information and will expect it to furnish the necessary knowledge and the constructive ability required in meeting new situations that make necessary the building of new plans of thought for community use. The contributions made by research in these institutions will generally tend to concern fundamental subjects and to group themselves on the more indefinite areas along the borders of knowledge, but it is frequently these broader principles which offer the largest opportunity for real addition to the sum of immediately useful information.

The fourth reason (*d*) for including research as a part of the necessary programme of an institution of higher learning involves one of the distinguishing characteristics of the university. By reason of the extraordinary scope of interests represented in such a body, one might expect the unusual opportunity for contacts of investigators in related fields to produce new combinations of formulae, and through these the opening of new fields of discovery. No other organization presents the same wide range of sub-

jects represented by leaders of thought who are normally investigators. To these conditions the university adds an unusual freedom of opportunity for choice of materials or combination of materials to be used in investigations, as also the stimulating influence of a continuous stream of students with new inquiries and new ideas. In no other type of institution engaged in investigation are the chances greater for contribution in fields representing either new groupings of subjects or areas which have thus far remained untouched by the workers of all organized departments of knowledge.

For all of the reasons that have been presented research has now an established place in institutions for higher learning. The position of constructive work in the universities is clearly not accidental but relates to the generic characters of these institutions.

To the university viewed as the highest training school, investigation becomes as necessary for natural activity as eating and assimilating are to continued effectiveness of the biological organism. The research so necessary to continuance of adequate instruction we come to recognize as a normal part of the life of the institution, and we look to this kind of an organization in the course of its growth to produce much of value in the forefront of discovery and construction.

The university fails of its mission in creative work in many instances because, of all the types of institutions, it is the most imperfectly financed for this phase of the work which it should naturally conduct. With the clear requirement that, to keep its position in the first line of advanced thought, it must consist of men of the best type in the professions the university is often financed almost exclusively for teaching and administration without reference to research, and it is assumed that the constructive work so necessary to development of the faculty and students will be cared for in other ways. Beyond funds for purchase of books, departments with large salary rolls

for instruction often show almost nothing for constructive work. The ultimate result of this policy must be failure to attain the full measure of efficiency. Potential leaders in the faculty will either find support of their greatest contributions to knowledge outside the institution, or failing in this they will burn out like a lamp producing feeble light by burning a wick to which no oil is fed.

The university, then, takes its place with other groups of research agencies of the country as an institution caring for the initial training of nearly all investigators, and particularly given to wide range of investigations among a great variety of fundamental subjects. Its activities in constructive work will often run parallel with those of other kinds of organizations, but breadth of interest, wide range of contact, unusual freedom of relationship, and spontaneity will always be among its characteristics.



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